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Rockhounds' NATIONAL Magazine

Grand Coulee Dam—See page 9.

35¢

October Issue, 1958

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by

GEORGE LANGFORD

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EDITOR'S MEMO PAD

"Human happiness depends chiefly upon having some object to pursue and upon the vigor with which our faculties are exerted in the pursuit."

Joseph Priestly, (1733-1804)

EARTH SCIENTIST'S OPPORTUNITY!! Let us look to our *objectives* as well as to our *responsibilities.* How applicable is the above quotation from the pen of the immortal Priestly, to the personnel of our present day Earth Science club organizations. We sincerely believe that our club officers and sponsors will find increasing happiness in their work and even new zest for living, in direct proportion to the earnestness, thought and effort expended by themselves in behalf of their local club activities. To strive to make one's society something to be proud of is really worthwhile and in so doing your reward will be in the satisfaction one receives in knowing that his job has been well done.

As to our *responsibilities,* we must readily admit that one of the gravest social problems confronting Americans today is to provide, not only for themselves, but for their neighbors, those forms of wholesome recreation necessary to absorb our ever increasing leisure time. No one will deny the fact that mineral study, either as a hobby, or in any of its more serious aspects, will furnish opportunity for such profitable recreational facilities and employment for both old and young alike.

This fact has been demonstrated over and over again, both by sporadic efforts, such as occasional mineral outings and collecting field trips and by more permanent forms of mineral club work, which in the past few decades has been carried on successfully in practically every part of the country. Under proper leadership, mineral study in one form or another has never failed to interest and hold with ever increasing zeal almost all who have taken it up in earnest.

The question, therefore, which should now vitally concern all of our existing groups of Earth Science interests, is, in what manner may this genuine interest in the study of minerals be so stimulated and crystallized that literally scores of devotees will spring up throughout the land, where there are now only a few, so that many new clubs may be formed in regions where none exist today.

That, friends, seems to be our problem, and we are sure that with the proper cooperation of all concerned this can be worked out to the great satisfaction of everyone. Certainly, all will agree that this will take a lot of time, effort and energy, not only on the part of the leaders, but of all good mineral fans as well, if we are to succeed in getting such a drive across in a really big way. No movement of any kind may hope to succeed without level headed leadership, backed by widespread publicity and the unstinted support of all its legitimate constituency. This leadership will in the large, have to develop out of the rank and file of those who are already familiar with "Mineralogy's Opportunity," that is to say our present club membership.

We, also are fully aware that a great many of our readers will reside, perhaps in sizeable communities, even cities, where no organized mineral club or study group exists today. Having this in mind may we rather tactfully take this opportunity of doing a little missionary work on the subject. Why not call in a few of your like minded friends and talk over the matter of organizing a club. If help is needed, or definite ideas lacking, we are certain that neighboring societies will gladly help out, and that your regional Federation secretaries will have and gladly furnish you with helpful literature upon the matter of organizing a society. The Midwest secretary will cheerfully send out such literature upon request. Nuff said.

* * *

ATTENTION ILLINOIS PROGRAM CHAIRMEN: The new 16 mm color film, "Illinois Holiday," sponsored by the Bell Telephone Company, should prove of unusual interest to all out-door fans, including rock-hounds, showing as it does many of the geologically scenic and historical spots throughout the State. To reserve this film—free of charge, call your local telephone business office.

* * *

Atomic Energy Pictures Released. Club Program Chairman Attention!—Eight scientific motion pictures produced by the Argonne National Laboratory have been selected for presentation at the Second International Conference on the Peaceful Uses of Atomic Energy at Geneva, Switzerland, September 1-13. These pictures are among 45 films accepted for showing at the Geneva conference by the U.S. Atomic Energy Commission and the Office for International Conference.

George W. Lindholm, Jr., staff assistant at Argonne and writer director of the films, said:

"We hope the films will help keynote America's progress in atoms for peace to overseas nations."

The Argonne motion pictures—along with the others—will be prepared in four languages: English, French, Spanish and Russian. After the conference, both English and foreign language versions of Argonne's films will be placed into commercial sale *and loan channels.*

Two of Argonne's films are scheduled for showing in the United Nations theatre at the Geneva conference. They are: 1) "Fast Reactor Program" and 2) "Experimental Boiling Water Reactor." The original version of this film received an international award.

Five more Argonne motion pictures will be presented in the United States exhibit at Geneva. They are: 1) "Experimental Breeder Reactor I Core Disassembly After Meltdown"; 2) "Experimental Breeder Reactor II Fuel Cycle Development"; 3) "Experimental Breeder Reactor I Mark III Core"; 4) "Zero Power Reactor III"; and 5) "Argonaut." The eighth film—"Ionizing Radiation in Man"—has not yet been assigned to a section. All eight of the Argonne films to be shown at Geneva are in 16-millimeter color and sound.

The Argonne National Laboratory is operated by the University of Chicago for the U.S. Atomic Energy Commission, and is located on a 3,700 acre tract of land 25 miles southwest of Chicago near Lemont, Illinois.

* * *

COVER PHOTO: *Grand Coulee Dam.* View looking southwest over Grand Coulee Dam at the upper Grand Coulee. Prominent in the photo are the Dam Spilling during the flood season, the pump discharge lines, the Feeder Canal, North Dam, the Equalizing Reservoir and Steamboat Rock in top at left center. Photo Courtesy of Bureau of Reclamation.

* * *

Our Authors: Frank L. Fleener who has written so interestingly upon the subject of fulgurites (petrified lightning) has affectionately been called the "grand old man of mineralogy." He resides in Joliet, Illinois, but has just recently celebrated his 80th birthday (August 19th), at the home of his daughter Mary, wife of Dr. James Ahern in Seattle, Washington. Fleener is co-author of "Quartz Family Minerals", and has written scores of articles upon a wide variety of subjects which have from time to time been published in the several Mineral Magazines. Before his retirement in 1943, he was head of the Geology Department of the Joliet Junior College—the first of its kind in America.

Midwest Club News

BERNICE REXIN, *Club Editor*
3934 N. Sherman Blvd.
Milwaukee 16, Wisconsin

Des Moines Lapidary Society will hold a "Rockhound Round-Up" October 18-19, in the new Veteran's Memorial Auditorium in Des Moines, Iowa. At least six educational lectures will be presented and one of the featured speakers will be Hazen Perry, President of the American Federation of Mineralogical Societies. There will be demonstrations on gem-cutting and jewelry-making; sales of domestic and imported gem-cutting materials; displays of gems, jewelry, and minerals; and a room for visiting and swapping. A professional snack bar will serve the visitors. All rockhounds will be identified with name tags and those having material to trade will be given a trading tag. Visitors are welcome.

Cincinnati Mineral Society on June 25 heard Professor Richard Durrell of the Department of Geography and Geology, University of Cincinnati, give an informative and entertaining talk on "Spain." Professor Durrell's lecture was based on his experiences and the observations that he made during a six-week motor tour that he and Mrs. Durrell made of Spain during the summer of 1957. The talk, which was illustrated by maps and splendid Kodachrome slides, included the customs of the people, the mining of cinnabar and iron, and solar evaporation of ocean water for salt.

Madison Geological Society chartered a bus for a fossil-collecting trip in eastern Iowa on July 27. Stopping at Graff, Iowa, where the basal Maquoketa is exposed (Depauperate zone), the group found graptolites in the shales and a coquina of Michelinoceras cephlopods. At Monticello, Iowa, on the south bluff of the Maquoketa river, they gathered silicified casts of fossils from a Silurian Niagaran coral reef.

Minnesota Mineral Club made a field trip to Royalton, Minn., on August 17 for Lake Superior Agates. MMC reports that member George Rikert has just completed a fossil wall for his yard. The wall is made of cinder blocks with mortar in which Mr. Rickert has embedded beautiful specimens of fossils.

(Continued on page 7)

Bulletin Editors, please note. Kindly check your mailing list and if our Club Editor's name is not on your list, or incorrectly given please include or make correction, as this will greatly facilitate the task of the Editor.

B.H.W.

18th Annual Convention of the

MIDWEST FEDERATION OF MINERALOGICAL AND GEOLOGY SOCIETIES

as reported by
Mrs. Charles E. Hemingway, Past President

The Earth Science Club of Northern Illinois, better known as ESCONI, of Downers Grove, were hosts for the 18th Annual Midwest Convention on June 19th-22nd, 1958, which was held in the gymnasium and large cafeteria of the Downers Grove High School. Eight other class rooms arranged along a connecting corridor were also used for special exhibits.

Displays were well arranged and there was ample room to view each one leisurely. The show of group and individual exhibits was breathtaking,—what man can achieve with a piece of the good old earth. Dealers materials were easy to look at and you could ponder your purchases of polished and finished work as well as minerals and slabs in the rough.

Mr. Howard Knight, Midwest President, who was also president of ESCONI, is to be highly commended for putting on such an outstanding show and convention. Mr. Verne I. Montgomery, general chairman seemed to be in all places at once and had everything under control. A public address system kept us constantly informed of what was going on and what was coming up next. Prizes for lucky drawings on admission tickets were awarded every hour.

It is often so very difficult to bring back the atomsphere and inspiration of such a convention, to inspire more active and intensive participation on the part of each member in our local societies and in the Midwest Federation. As a hobby, there is nothing that excels the reward of turning out a finished piece, or collecting rare specimens of rocks and minerals and fossils, or viewing the accomplishments of fellow hobbyists, be they geologists, paleontologists, lapidarists or what have you, as is always so perfectly obvious at a convention such as this.

The program of lectures and pictures was instructive, and very well attended, being very much enjoyed by those who took advantage of them. The lecture on the *"Geology of the Black Hills"* had to be witnessed to be enjoyed. Dr. Paul Wright, geologist from Wheaton College, had a way all his own telling about these formations so impressively that you could actually feel the rocks moving and see water running, resulting in this nature's wonderland.

Dr. George Otto, a consultant in economic geology, and often in Washington, D.C., California, Michigan, Missouri and Brazil, prospecting for oil and other minerals, gave us a fine picture of the *"Geology of the Chicago Region"* and was well qualified to keep you spellbound for hours. Mrs. Ruth Kirkby, a resident of Riverside, California, showed most excellent colored slides as she gave her instructive lecture of *"Fossil Flora and Fauna."* Margaret Cunningham's story on *"Oregon Thundereggs"* which too was illustrated with colored slides, was also very well received.

At the Argonne National Laboratory, Lemont, Illinois, which we visited, is the high level gamma irradiation facility for research purposes and irradiation of samples in this facility, which is one of a number of services that the Laboratory offers industry and other organizations. It is an intricate operation. Food irradiated can be kept without spoiling and is edible without the flavor being changed, as vouched for by those who have eaten it. At the present time it is still an expensive process. Our guide, Mr. E. W. Phelen, gave us this definition of relativity: "Where there are relatives there is a will." He defined an atom as a miniature solar system. "Know more about nature" is the theme of the Laboratory.

The Editor's Breakfast got us all acquainted and talking at the same time. Earl Eisenhower, brother of the President, judged the Bulletin Contest and made the awards for the best selected with a few well chosen comments upon the merits of the respective publications. Ben Hur Wilson, Editor of Earth Science, spoke briefly upon the importance of the Club Bulletin and that of the position of the bulletin editors. Russell MacFall, night editor of the Chicago Tribune MCed the program in his usual witty manner. The annual banquet supported an overflow crowd and was enjoyed by all who attended, as was Dr. Wright's lecture which followed.

The various field trips were well selected and successful. An eight-section caravan of 104 automobiles, carrying possibly some 400 rock-hounds made a very satisfactory trip, Sunday, the closing day of the convention, to the Mazon Creek-Braidwood fossil collecting area. This unforgettable experience was so

much fun, for to be able to take your rock hammer and crack open a nodule and find a fern leaf in perfect condition, perhaps millions of years old, is a thrill you can have only by doing it yourself. Many fine specimens were found.

The Miami Valley Mineral and Gem Club, of Fairborn, Ohio has been tentatively selected as host to the 1959 Convention, which would be held at Springfield, Ohio. The 1960 Field Trip Conclave will be held at Ishpeming, Michigan. The Midwest is now composed of 53 affiliated societies, and many more will be added during the coming year.

The following officers were elected for the ensuing year.

OFFICERS 1958-59

LaFayette Funk, President, Shirley, Illinois; J. W. Pagnucco, Vice-President, Wyoming, Ohio; Bernice Weinrank Rexin, Secretary, Milwaukee, Wisconsin; Orval M. Fether, Treasurer, Downers Grove, Illinois; Ben Hur Wilson, Historian, Joliet, Illinois.

N.B. The convention was held too late to have this report included in our June-July isue which was already on the press at the time. B.H.W.

* * *

VERY EXTRAORDINARY!!

PITTSBURGH GROTTO reports that its members have discovered a new type of cave formation. Due to its unusual properties, this formation has been named "invisibilite." Invisibilites are characterized by a totally uninteresting appearance and have almost a complete lack of substance. They have been found to occupy the position of formerly beautiful formations in a number of caves. The first invisibilites noted had replaced the two-foot long gypsum needles in the sewing room of Higginbotham Cave, Tennessee. Every needle over six inches long had been converted into an invisibilite by an unknown force. The spelunkers who discovered these invisibilites surmised that they were caused by the fungus parasite, *Vandalis Destructus*, often carried into caves by the animal species *Homo Sapiens*.

The consensus of geologists, mineralogists and archeologists, however, is that this strange formation is caused by rogue rockhounds, that is rockhound members of *Homo Sapiens* who have lost their sapience. They are also responsible for such phenomena as unclosed gates, broken fences, smoldering fires, trash, and open diggings. "No Trespassing" signs usually mark the sites which they have visited.

(Club News—Continued from page 5)

Miami Valley Mineral and Gem Society celebrated the Fourth of July with a trip to the Brown County State Park in Indiana. In a small stream the visitors panned for gold and obtained a few flakes. They also found some garnets and corundums. In another stream they found some good geode specimens. A really nice one contained smoky quartz crystals on pink chalcedony. In an abandoned quarry they gathered some beautiful pink dolomite and a small amount of millerite.

Nebraska Mineral and Gem Club will hold a non-competitive mineral and gem show on October 4-5 in the Ballroom of the Rome Hotel in Omaha, Nebraska. Members of the club are building 20 display cases for the exhibits of gems, jewelry and fossils. The cases are being finished like a fine piece of furniture and will be offered for sale after the show. Eight dealer exhibits have been arranged for and more are expected. A small entrance fee will be charged. Visitors will find good parking facilities and lodging is available at the hotel.

Chicago Lapidary Society recently viewed John Ott's colored movie, "The Story of Our Changing World". Included in the film were spectacular scenes of Yosemite and the Grand Canyon and the story of their origin. Also shown were Mr. Ott's beautiful time-lapse movies of flowers, growing, blooming and fading.

Kalamazoo Geological Society on July 7 was shown "Navaho Indians," a colored film dealing with the life of the Navaho Indians. Included in the movie was a scene on jewelry-making, an important craft of the modern Navahos.

Chicago Rocks and Minerals Society recently was shown a splendid collection of colored 3-D slides of mineral specimens. The slides were produced by Reo Pickens, who is a member of the club and a professional photographer. He has also made a series of colored postal cards depicting mineral specimens, and many of the colored plates on minerals in some of the books on the market were made by Mr. Pickens.

Indiana Geology and Gem Society panned for gold on July 20 in a creek in Morgan County, Indiana. The gold found in this area and a few diamonds were deposited by the glaciers. No one gets rich on these gold-panning expeditions, but they do have a lot of fun.

Earth Science Club of Northern Illinois recently completed a series of discussions for its junior members on Lincoln Barnett's essays about the "World We Live In." The first four essays were devoted to the physical

(Continued on page 30)

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OCTOBER, 1958 Vol. 11, No. 5

Skeleton and Fossil in the *GRAN COULEE*

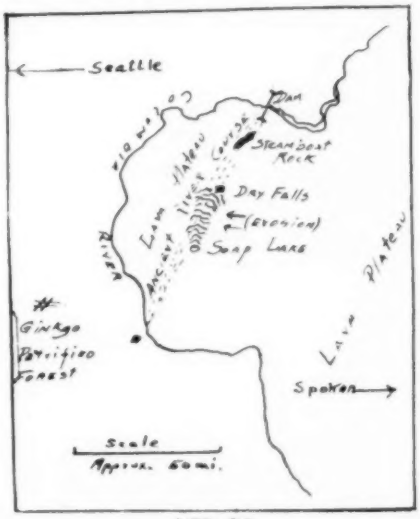
by JO HINDMAN

A GIGANTIC skeleton and unearthed fossils exist today, testifying to occurrences that took place on an American plateau before the dawn of recorded history.

The dust blown precipice, known as Dry Falls, represents the skeleton of one of the greatest cataracts ever to exist upon earth.

Ancient fossils are tree trunks, protruding here and there from forests of petrified wood that lie pressed, layer upon layer, between the hardened slime of ages. Most outstanding fossil find—the leaf, nut cache, and wood of the rare Ginkgo tree—provides the fossil storehouse with its modern name, the Ginkgo Petrified Forest.

Petrified forest and Dry Falls lie in the vicinity of each other in central Washington, northwest United States, situated in a prehistoric river bed, named appropriately by aborigines as the *gran coulee,* or big ditch. Destinies of the *gran coulee,* the forest, and the cataract were once intertwined. No doubt, the activity of one influenced the other in a colossal round-robin of prehistoric cause and effect that lasted through untold geological ages. The sunbaked results lie passive and visible today; some say, fifteen million years later.



SITE OF
ANCIENT ICE DAM
(Present Grand Coulee Dam)

Evidence shows that massive oozings of molten lava came first, pouring from cracks in the bald mother-granite, glowing red in the black of night, shimmering under heat waves in the pale of primeval day. At that distant time, the area was a vast granitic basin corrugated by many low mountain ranges and valleys, and bisected by a nameless, boisterous river.

Volcanic extrusion continued, alternating with long periods of quiet, pushing northward and shouldering the river aside to the west. The lava flows numbered approximately fifty throughout the centuries, building to a thickness of thousands of feet, filling original valleys, covering the tops of low mountains, and

COVER PICTURE: The *gran coulee,* or big ditch, stretches southwestward (top) from site on ancient ice dam where stands 20th century's Grand Coulee dam. Siphons (left center) conduct irrigation water over lava ridge where formerly spilled the waters which carved the prehistoric riverbed from the lava plateau. Interesting landmark, Steamboat Rock, looms in mid-channel (top, left).

Dry Falls, Washington, stands as a monument to the arrested action of an ancient watercourse, forerunner of the Columbia river which bypasses these cliffs, today. At foot of cliffs is Falls Lake.

sandwiching forests in between. When completed, the volcanic work resulted in a lava plateau about 200,000 square miles in area, covering central and eastern Washington, part of adjacent Oregon and Idaho, and exceeded in size only by the Deccan plateau in India.

Archeozoic, Proterozoic, and Paleozoic ages, by then, had come and gone. The next, Mesozoic, or middle life, was characterized by dinosaurs which roamed the steaming swamps of western United States, and perhaps fed from the stubborn tree life which sprouted, grew, and fell before recurrent and flaming onslaughts of entombing lava.

Ages continued to unroll, each contributing its marvel of Creation. The Ice Age was precipitated by changes in climate due to geological activity. Disturbances created mountains, including the present Cascade range which replaced an original chain and separated the State of Washington into two climatic regions.

Vast glaciers from the north pole made four advances and retreats into Europe and North America. One of these dammed the basin's primeval river, now called the Columbia, at a point in present central Washington, and caused the river to pour its waters over the very lava that had displaced it in earlier ages. The big ditch, the *gran coulee*, was now in the making.

Engineers of the Twentieth century have erected Grand Coulee dam at, or near, the site of the ancient ice dam.

A distance represented by an imaginary line, slightly southwest to north, eighty miles in length, then as now, separated the ice dam site from the buried forests which were undergoing the process of petrifying. At a point midway on the foaming active river racing across the lava plateau, some falls began to form, appearing first as white-capped rapids where the rushing water was nibbling at weaknesses and rifts in the hardened lava.

Over a span of countless years, the erosion traveled twenty miles, working upstream from present Soap Lake. At a final and historic last stand, the mighty river boiling southward through its carved channel, the *gran coulee*, hurled itself from the brink of a gigantic precipice,

four hundred feet high and three miles wide. It is likely that no human being ever gazed at that long-vanished spectacle of thundering, plunging waters, nor felt the dampness of obscuring mists of spray, nor heard the deafening volume of sound. Yet, while no human eye may have gazed upon it, the record of its existence is so plainly written in the topography of the region that to the traveller of today, the mighty natural drama seems to have swept by only moments before, leaving a shallow lake of waters lying at the foot of the lava cliffs.

Throughout the Ice Age, the climate moderated. The glaciers began their last retreat from the area; in time, they vanished. When the ice dam that had altered the normal course of the Columbia river disintegrated, the lake behind which diverted water into the *gran coulee,* disappeared. The water level dropped, the river again sought its post-volcanic course —also its present course—and resumed flow through the valley skirting the western edge of the lava plateau. The falls and the *gran coulee,* literally, remained high and dry.

Downstream at a bluff overlooking what is now the small settlement of Vantage on the Columbia River, a prospector searching for minerals stumbled upon a half-imbedded curiosity which later was identified as a petrified tree stump. Exciting excavations ensued, exposing additional finds. Broad leaved maples, sycamores, hickories, chestnuts, beeches, and oaks were dug up in surrounding foothills while the lower river valley, once bordered with swamps not unlike those of the Mississippi, yielded fossils of trees preferring moistness, such as the mahogany, cypress, acacia, bald cypress, tupelo, gum, teakwood, persimmon, magnolia, rosewood, and black cherry. The area must have been a succession of gigantic log jams composed of specimens floated by tributary rivers draining the Columbia basin.

Wood petrifies when vegetable cell structure is surrounded or replaced by minerals. The wood must be deeply buried so that little oxygen is available, halting bacteria decay or causing it to work slowly. Also, wood must be impregnated by a solution, usually of silica, that later hardens into a mineral. All these conditions con-

Museum of Ginkgo Petrified Forest, inside and outside, exhibits large array of tree fossils. Fossil-studded grounds stretch on both sides of Highway 10, near Vantage, Washington.

ducive to petrification of wood were present at this unique spot on earth, now known as the Ginkgo Petrified Forest.

Fossil Ginkgo leaves have been found elsewhere, in Greenland, Great Britain, Canada, Siberia, China, Japan, and Australia, but Washington's petrified forest is the only location where petrified Ginkgo *wood* has been found.

The modern Ginkgo is the only surviving species of an ancient tree family. Nowhere in the world does it now exist in the wild state. It has been cultivated for years in Chinese temple gardens and revered as the "sacred tree of the Orient." The fan-shaped Ginkgo leaf is found on no other flowering plant, but most closely resembles a maidenhair fern leaf. Early Chinese literature refers to it as "the tree with leaves like a duck's foot."

In addition to Ginkgo specimens, the museum on the grounds exhibits more than two hundred petrified tree species excavated on the spot, representing more than fifty genera and including Norway pine, monkey tree, butternut, juniper, Pacific yew, honey locust, elm, wax myrtle, ash, redwood, and Philippine mahogany. An interesting trail has been laid out over the adjacent lava terrain which leads to massive rooted stumps of ancient trees standing upright on the spots where they once grew.

Identification of petrified wood specimens, whose beauty resembles handsome onyxes and semi-precious stone, is made possible through magnified photographs showing unmistakable cell structures, unique to the various woods. As reliable a medium of identification as is the human fingerprint, the marvel of photomicrography enables the human eye to recognize, verify, and view secrets of nature that have laid buried throughout passing ages.

In addition to central Washington, six other areas in the United States are noted for petrified forests, but none possesses as many species as the Ginkgo forest, no other can claim the Ginkgo tree as native and, with the exception of eastern Oregon and adjacent Idaho, in no other place are fossil logs found imbedded in once-molten lava.

Nowhere in Creation has natural drama starring a big river, a forest, and a gigantic cataract, been enacted just so. Bubbling stone, liquifying ice, leafing forest, and gouging water all existed there once, but are gone now. Marvellous and awesome, indeed, are the traces they have left behind.

OKLAHOMA GEOLOGICAL SURVEY: One of the most active and outstanding State Surveys in the entire country is located at Norman, Oklahoma, seat of the State University. "Oklahoma Geological Notes," published bi-monthly, is the official publication of the Survey, and each issue contains many notes and articles of exceptional value, to Earth Scientists who are interested in general geological subjects, or in some of the special fields, such as paleontology, et cetera.

The current June-July issue is of unusual interest, containing as it does splendid articles by such well known geologists as L. R. Wilson and Robert O. Fay. The latter's article on "A Key to Conodont Genera and Subgenera," with 132 specimen illustrations and bibliography, should prove invaluable to all students of the subject. A list of all other publications of the Survey, giving cost, may be obtained from the Survey office at Norman upon request.

BOOK REVIEWS: "Mineralogical Journeys in Arizona," authored by Arthur L. Flagg, Past President of the American Federation, and noted geologist, comes now as a highly valuable contribution to all collectors interested in the minerals, and the mineral collecting fields and localities of the great State of Arizona. Mr. Flagg, known far and wide as the Dean of Mineral Collectors, having spent more than 50 years collecting and doing field work in Arizona, as mining engineer and consultant, is without doubt the very best qualified person available to write upon this subject.

This book contains the first complete list of minerals of Arizona, also many colored pictures of rare minerals, and an interesting and authoritative section upon old abandoned mines, and mineral locations, not to be found elsewhere. Beautifully cloth bound, First Edition copies can now be obtained from Mr. Flagg, P.O. Box 2345, Phoenix, Arizona, for $3.95 per copy, postpaid.

PETRIFIED LIGHTNING

by **FRANK L. FLEENER**

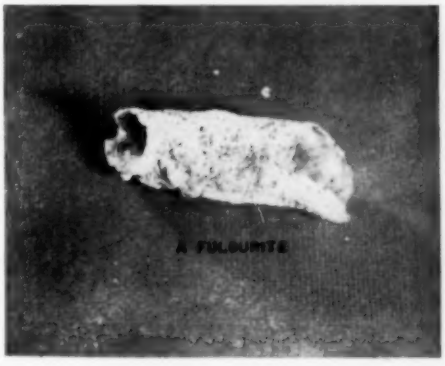
"FULGURITES" is the proper name for those scraggly, glassy tubes that are produced by lightning discharging into and fusing the sand of a dune. Seemingly, these peculiar freaks of nature are not too well known to the mineral collecting fraternity, as is attested by the fact that but few collections ever contain specimens of this interesting material.

As far back as the Middle Ages these glassy tubes were known, and, along with fossils and meteorites, were grossly misunderstood. As was customary in that superstition-ridden age, they were accorded with mystical powers. For instance, one German savant, Pastor David Hermann, of Massel, Silecia, while compiling a pharmacopoeia of the time, recommended their use in powdered form in cases of fevers, humous, and febrile disorders. History fails to state clearly how many trusting sufferers passed on to their reward from being fed powdered glass.

Moreover, the good Pastor Hermann was not content to let the matter rest at this point, but put down in careful script one of the earliest suggestions of the origin of these tubes that we have, published in 1711. He writes—"The vitreous tubes are similar to melted glass. They grow in the yellow sand and upwards out of the depths of the earth . . . (it) is not often found on the surface. But in May or June it is forced by nature to bore up into the surface, and strike through the sand, and its end there upon either breaks off of itself or is struck off by the passing over it of men, animals or wagons, and some beautiful pieces are found."

To people living in the ultra-scientific age of the twentieth century, this obvious misstatement of fact appears passing strange, but when we recall the fact that in his day science had not as yet discarded its swaddling clothes, and that even in cultured Europe there was a peculiar idea that all things grew, even stones, minerals, ore veins, etc., we should not be too surprised at Pastor Hermann's bizarre misstatement.

Gradually, as time progressed, towards the beginning of the nineteenth century the true nature of fulgurites came to be recognized. The matter was probably settled for all time by a paper written by D. W. Withering, an English mineralogist, published in the Philosophical Transactions, London, 1790, in which he relates the story of a man standing under a large tree during a thunder storm in Aylesford, England. A bolt of lightning struck the tree and killed him, the current passing down a metal-tipped walking cane upon which he was leaning. Where the cane rested on the ground, the lightning "bolt" made a round hole about five inches deep. No further investigation was made at the time, but shortly thereafter Lord Aylesford determined to set a monument on the spot, with an inscription warning others against seeking shelter under trees during thunderstorms. Workmen digging for the foundation of the monument, found typical fulgurite material, some of which was turned over to Withering, who described it in the aforementioned paper. In this case there could be no doubt cast upon the origin of the specimens. Later, excellent descriptions of fulgurites appeared in the writings of



Humboldt, Bompland, and Darwin, and others.

In view of the fact that subsequent investigations indicated that not all natural glass was formed in the same manner, it became expedient to formulate a group name, to include the whole family of natural glasses. The term LECHATELIERITE was chosen for this purpose.

Fulgurites, the principal subject of this little study, is the most common member of the group. They are comparatively rare, since conditions for their formation must be just right. These objects are commonly designated specifically as " 'sand fulgurites'."

Then there are what is termed Rock Fulgurites, consisting merely of irregularly-shaped fused masses, or as glazes of different colors and thicknesses, depending upon the composition of the rocks that were struck by the lightning. The glassy glaze is formed on the surface of the rock, often resembling a coat of varnish. The minerals of the rock beneath in most cases being only partly fused, the more refractory minerals remaining unaffected. Examples of this type of lechatelierite are most commonly met with in mountainous regions, as in Mexico and Colorado.

A third class of lechatelierite, which has a slightly different origin, has been assigned a place in this group. It has been noted that when a huge meteor plows its way through the earth's atmosphere at a tremendous velocity, the terrific heat generated at the impact, fuses the sand and surfaces of the rocks into a glassy-glaze. A notable example of this situation is to be seen in Meteor Crater, near Winslow, Arizona, and elsewhere.

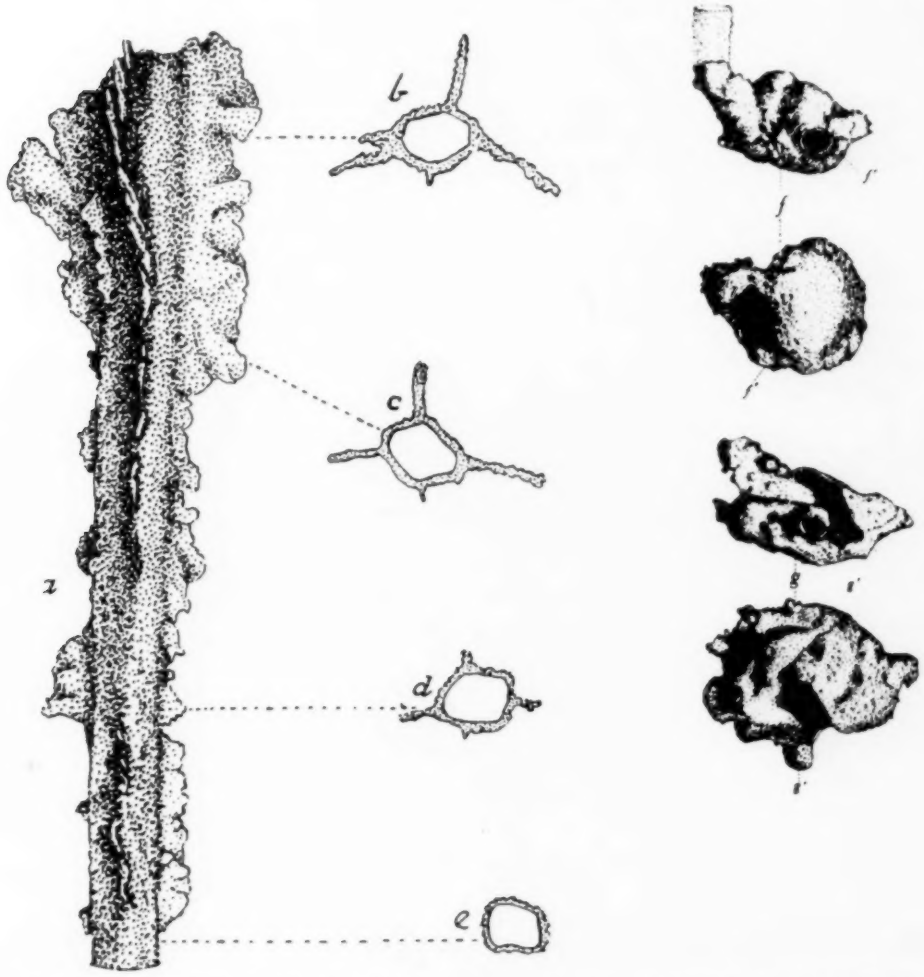
To these three types of naturally-produced glass there has been added two more that man has been responsible for producing. In December, 1938, a high-tension transmission line, carrying 15,500 volts of electricity, was blown down during a violent storm near Indio, California. The current passed into the sand of the valley floor for some time, producing an artificial fulgurite of spongy glass which covered a considerable area. In such

G. F. Hill examining his collection of Nag's Head, N. C., fulgurites.—North Carolina Dept. of Conservation

cases the electrical discharge melts the sand, which quickly hardens into a spongy glass that branches and sprangles, according to the path of the current. Many of the branches outwardly resemble true fulgurites but are not hollow, which is a characteristic of true sand fulgurites.

Again, early on the morning of July 16, 1945, a group of nuclear scientists triggered the detonation of the world's first A-Bomb, in the remote New Mexican desert. The tremendous heat resulting from that blast fused the materials of a considerable area into a form of glass, to which the name Trinitite has been tentatively given. Some mineralogists have suggested that this and glass from other such explosions be given a place in the lechatelierite group.

Some of the most tantalizing questions concerning fulgurites were answered, some years ago, by the Westinghouse Laboratories, who carried on a series of experiments, mainly to determine the temperatures required for the formation of fulgurites. It was learned that a temperature of over 5,000 degrees F,—the temperature of the electric arc,—was neces-



Drawing: Portion of the Stanton County fulgurite showing wings at approximately right angles; b, c, d, e, cross sections at indicated points; fulgurphysa from ends of tubes.—Courtesy of Nebraska State Museum.

sary under favorable circumstances, to form the tubes. According to Dr. P. L. Bellasche, who conducted the experiments, natural fulgurites are comparatively rare, since conditions for their formation must be just right. First of all, the sand must be of the proper composition to fuse into the pasty glass-like material of the tubes. Various mixtures were tested, and it was found that a sand containing nearly 80% of silica sand and about 10% of aluminum oxide gave the best results. Such impurities as were present were absorbed by the glass and are responsible for their color. Secondly, it is also of prime importance that the sand be dry, moisture interfering with the passage of the electrical discharge. This fact explains the fact that fulgurites are more common in desert regions than elsewhere. Moreover, in some regions—as for instance in western Nebraska, where a close study has been given to these glassy tubes—observation shows an exact ratio of moisture in the sand, that is so effective that in certain dry seasons many fulgurites appear to be formed, while in wet seasons there are few or none. A thunder-bolt striking the earth travels downward through the sand in a tortuous but generally vertical direction, but on reaching layers that contain a little more moisture, the electricity follows them, branching and rebranching into arborescent forms until the force of the bolt is spent.

The controlling factors in determining the length and diameter are given above, assuming that the lightning strokes to be of equal potential—a factor that remained darkly inscrutable. It is to be noted that the length and diameter of fulgurites may vary greatly. In extreme cases some have been reported over thirty feet in length, and two inches or more in diameter, but the majority of them are in the neighborhood of ten to fifteen feet in length.

Fulgurites taper more or less rapidly according to conditions, the upper few feet showing no branching, but the surface showing major ridges or wings arranged roughly at right angles appear. The nature of these wings is not well understood. The outer surface of the tube appears rough, granular and sandy, dark gray in color; the inner surface, in contrast, presents a clean, smooth, and glassy appearance, often black from the contained iron and other impurities.

At the extremity of the fulgurites, more or less flattened, bubbles of glass may be found. These Dr. E. H. Barbour, of the Nebraska State Museum, has named fulgurphysae. These terminal bubbles appear to represent the last effective energy of the electric current. Sometimes, however, the branches may end in diffuse flattened sheets of partly fused material. Evidently sufficient heat remained from the discharge to melt the sand and create a large volume of steam. The steam pressure in the cavity at the moment was sufficient to expand the walls of the cavity against the resistance of the weight of the surrounding sand. The expansion of the vitreous-lined walls of the cavity from its primary thickness resulted in a general thinning of the walls and final rupture, causing them to collapse.

It is a foregone conclusion that fulgurites are devoid of inherent beauty of either form or color, and to most folk they appear as unattractive curiosities,—freaks of nature, but a study of the stupendous forces involved in their genesis, along with the historical interest attached to the group, certainly makes a specimen of this unique formation a desirable object in every general mineral collection.

CATLINITE: Stone of Sacred Heritage!

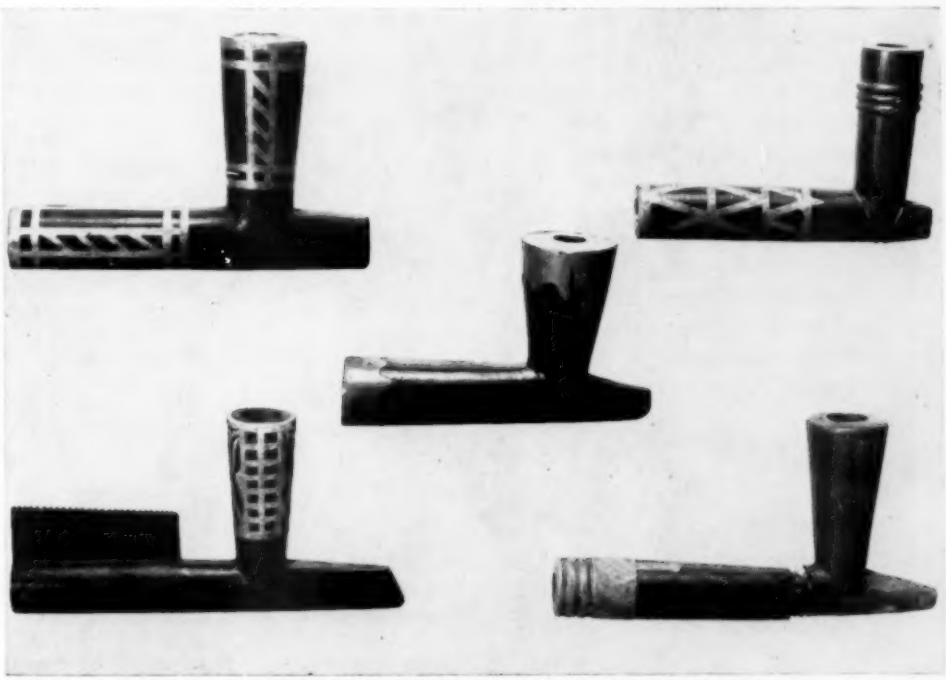
by BEN HUR WILSON

PIPESTONE NATIONAL MONUMENT: Dedication of the new facilities at the Pipestone National Monument took place on Saturday, the twenty-sixth day of July, (1958), at Pipestone, Minnesota, with dignified services and celebration appropriate to the occasion. Many notable personages were present to witness and take part in the activities which were held in conjunction with the 1958 Minnesota Statehood Centennial Celebration.

Historically famous, these Pipestone Quarries are located in the extreme southwestern corner of the State of Minnesota, east of the Big Stone Lake of the Dakotas. They have been worked by the Indians for untold centuries, and from them they secured the precious pipestone from which they fashioned the Calumet, or "Pipe of Peace" commonly used on ceremonial occasions, especially when treaties of peace were to be ratified.

During these ceremonies the peace pipe was passed around the circle of warriors present and each one took a solemn puff. Native tobacco, frequently mixed with sumac leaves or willow bark was smoked. These pipes were widely used and have been found in Indian graves and burial mounds over wide areas. When the region about the pipestone quarries was ceded to the "white man" these sacred spots were reserved in perpetuity for the sole use of the Indians and their descendants,—all others being forbidden to work in or remove the pipestone from the ledges, by the terms of the treaty.

The quarries also were formerly considered neutral ground among the warring Indian tribes, and many sacred traditions have been associated with the locality and its products. These traditions early became widely known and were mentioned by the poet Longfellow, being immortalized in the "Song of Hiawatha."



Indian "Peacepipes" of Catlinite and Steatite inlayed with lead.

"On the Mountains of the Prairie
On the great Red Pipe-stone Quarry
Gitche Manito, the mighty
He the Master of Life, descending,
On the red crags of the quarry,—

"From the red stone of the quarry,
With his hands he broke a fragment,
Molded it into a pipe-head,—"

The pipestone quarries were first visited by white men when the celebrated American-Indian traveler and scholar Catlin toured the then far West, and in his honor the name catlinite was given to the attractive red stone from which the peace pipes of the Indians were being made. When first quarried, before becoming well seasoned by long exposure to the atmosphere, catlinite was a softish argillacious (clay-like) material which could be readily carved and shaped by the Indians using only such ordinary tools as they might have in their possession.

Catlinite, however, is properly a rock and not a definite mineral species, being a fine grained mixture of various substances such as silica (quartz); feldspars; iron oxides; and other oxides of calcium and magnesium. While the Minnesota quarries were always the principal source of fine quality pipestone, it does, however, occur elsewhere, as upon the north shore of Lake Superior, at Nepigon Bay, and in Wisconsin.

Genuine, ancient Indian pipestone pipe artifacts are now indeed rare collector's items, and the better ones are quite valuable. In recent years, however, the market has been flooded by literally thousands of crudely made imitations of pipes and other trinkets made by white men who cater to gullible tourists passing through the region. These cheap, often gaudy, imitations are quite worthless and may readily be detected by anyone who will take the time to examine them carefully, and we think that this practice should be discouraged. What a sacrilege upon such a sacred tradition. Why not visit this famous locality sometime while traveling to the West.

ABRASIVE MATERIALS

by EARL D. CORNWELL

AS the word implies, an abrasive is a material that may be used to wear off or remove the surface of objects, in order to give them a desired shape, size or finish. This practice antedates civilization. Savage tribes used stones as far back as the Stone Age for such purposes as grinding corn, seeds, etc., as well as for making, sharpening, and polishing tools of both flint and metal; also for drilling and polishing of beads.

The thought of abrasives serving as the basis for a major industry was not actually recognized until near the close of the 19th century. The invention of the Universal Grinding Machine by Joseph R. Brown was the forerunner of this great advancement. Henry Ford's practical experience as a machinist enabled him to grasp the great advantages to be gained by grinding. As a result, many grinding practices, so common today, had their early development in the Ford shops.

Three primary qualities in an abrasive sand may be designated as hardness, toughness, and refractoriness, named in order of their importance. The mineralogist, Mohs, in attempting to measure hardness, set up a series of substances numbering them from 1 to 10 in a particular order so as to establish a specific reference scale by which comparative hardness of mineral substances could be determined. This series was based upon the fact that the minerals classed in any one of the ten designated groups could scratch any of those in the group immediately below and could be scratched by any mineral within the group immediately above. For example, any mineral within group 5 could scratch any mineral within group 4 and could be scratched by any member of those placed in group 6.

The principal objection to the Mohs scale, however, is that the steps are not equi-distant apart. Actually, the span from 9-10 is wider than from 1-9.

Efforts to convert these scratch-hardness values into more refined and realistic figures have been put forth by a number of investigators. An early revision table was published by R. R. Ridgeway and others (Trans. Electrochem. Soc., 63, 369 [1933]) which was actually an extension of the Mohs scale. It expanded the scope between 6-10 to 6-15, diamond representing the top value in each table. This revision was followed by a far more extensive revision by F. Knoop and others as described in detail in the Journal of Research of the National Bureau of Standards (23, 39 [1939]). The Knoop ratings were based upon the use of a very sensitive pyramidal-diamond tool so designed as to be able to make accurate indentation measurements in very resistant materials by the use of comparatively light loads. The results of the Knoop scale harmonize with those of the Ridgeway extension of the Mohs scale, although the

IRON-GARNET CRYSTAL

ALAMANDITE-GARNET CRYSTAL
In mica schist

Knoop hardness of diamond was placed at values ranging as high as 8,000-8,500.

Present day abrasive engineers roughly divide abrasive materials into two general classes: (1) The first class, presented by the first column below, comprises materials conspicuous for their hardness. They are listed in order of the Mohs (scratch) scale for hardness.

Abrasive Materials
Diamond
Boron carbide
Silicon carbide
Fused alumina
Garnet crystals
Quartz crystals, including sand

(2) The second column contains a miscellaneous collection of materials that have been found to have more or less value for cleaning, polishing, etc.

Polishing Materials
Feldspar mineral
Iron and steel (grit, shot, and wool)
Pumice
Infusion earth
Tripoli
Quicklime
Rouge and crocus
Selenium oxide
Tin oxide
Chromium oxide

Briefly, diamond is the peerless abrasive composed of crystallized carbon. It is the hardest of all known materials, except possibly a newly synthetic material which is reportedly somewhat harder. It is industrially used for such operations as saws for cutting minerals, drills for drilling rocks, powder for polishing gems, etc.

Boron carbide, B_4C, is an extremely hard, refractory, inert, black solid. It is second only to diamond in hardness, except possibly some of the more recent developments referred to above. It is commerically used as an abrasive in glass cutters, for manufacture of sand-blast nozzles, and for special mortars and pestles.

Silicon carbide, SiC, is an artificial abrasive compound resulting from the heating of sand and coke together with some sawdust in an electrothermal furnace, although claims that it has been found within certain meteorites have been recorded. It is harder and stronger than corundum and is commonly used in making grinding wheels for such materials as glass, granite, chilled iron, cemented carbides, aluminum, rubber, and leather.

Fused alumina is another type of artificial abrasive material produced by calcining bauxite in the presence of coke, the better grades of the former comprising up to 90% aluminum oxide, Al_2O_3. Fusing is normally carried out in electric-arc furnaces, and the finished product finds wide application both as an abrasive material and for the production of refractories.

Silicon carbide and fused alumina represent the two main types of commercial, artificial abrasives. They are complementary in their uses and for the most part do not compete with each other. For example, silicon carbide is commonly used for grinding materials of low tensile strength, such as aluminum and cast iron, because of its extreme brittleness. Fused alumina, on the other hand, is used on materials having high tensile strength, such as steel, due to its property of unusual toughness. As a result, the production of the latter far exceeds that of the former.

Garnet represents a group of complex silicate materials varying in hardness from 6.5 to 7.5, according to the Mohs scale. It is commonly used as an abrasive material, generally for the production of abrasive papers and cloths. Fine garnet sand is used throughout the U.S. in polishing of glass, some types of metal work, and as an ideal abrasive in the production of leather goods.

Quartz, a crystallized form of silica, is one of our most common natural minerals. Although it has a hardness of 7, it has a brittle, shell-like fracture. It is commonly used in making true "sand-paper", an inferior grade of abrasive goods, as compared to any of the foregoing abrasive

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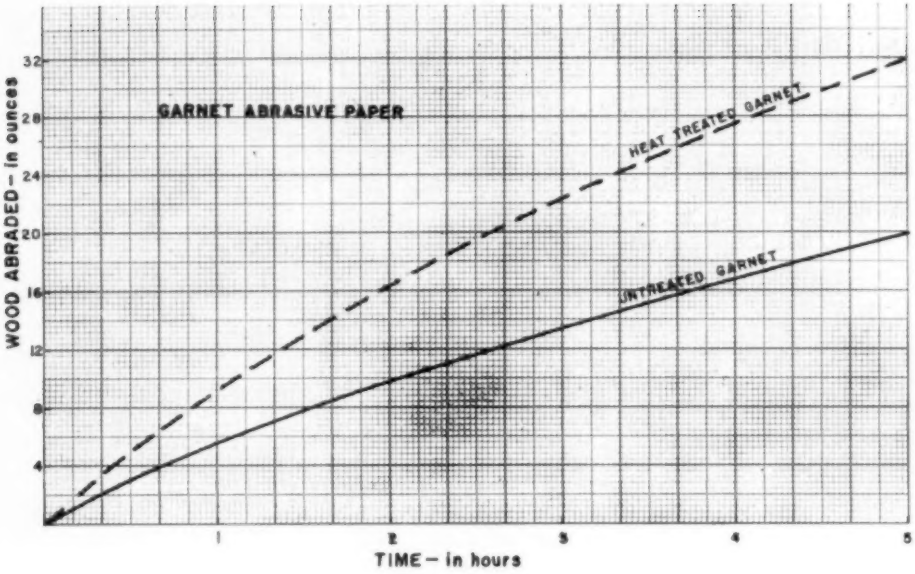

materials mentioned. It is commercially designated as "Flint." Powdered quartz is commonly used in soaps and scouring powders.

In view of the foregoing brief general resume of abrasive materials as used throughout the Abrasive Industry, it was decided to relate a somewhat more detailed story of the part played by one specific mineral, namely, garnet.

Garnet is a natural abrasive, a mineral which is mined from deposits in mountainous areas, particularly from the Adirondack Mountains of upper New York state. Idaho and Florida rank second and third in that order. It is usually found associated with granite, hornblende, quartz, mica, biotite, and magnetite. Most of it is mined from open pits.

The garnet group comprises a complex series of minerals containing calcium, magnesium, manganese, ferrous and ferric iron, chromium, aluminum, silicon and oxygen. Seven specific varieties, depending upon composition, have been distinguished as follows:

1. *Grossularite* (Cinnamon stone) is a calcium-aluminum garnet. Yellow, green, and orange varieties are used as gems.
2. *Pyrope,* is a magnesium-aluminum garnet. In some cases, calcium and ferrous iron may partially replace the magnesium. Commonly known as *Cape ruby* or *Arizona ruby,* it is frequently found in association with diamonds.
3. *Spessarite* is a manganese-aluminum garnet which may also contain both ferrous and ferric iron. Occurs in granitic rocks with topaz, tourmaline, quartz, and orthoclase.
4. *Rhodolite,* a pink or purple variety of garnet intermediate between pyrope and almandite. Used as a gem, as well as an abrasive.
5. *Almandite* (Carbuncle) is a ferrous iron-aluminum garnet which may also contain magnesium and ferric iron. Transparent, red varieties are known as precious garnet and used as gems. Translucent varieties are called common garnet and used almost exclusively as *garnet abrasive.* The most common source in U.S. is Gore Mountain, Warren County, New York, where it is commercially known as garnet.
6. *Uvarovite* is a calcium-chromium garnet which is emerald green in color.

It is not a common variety.

7. *Andradite* is a calcium-iron garnet whose composition varies greatly. A yellowish or greenish variety, resembling topaz, is called *TOPAZOLITE*; a grass-green variety is called *Demantoid*; while a black variety is called *Melanite*.

Of the foregoing varieties, pyrope and almandite furnish most of the gem materials, while the latter with andradite, are common in the abrasive trade.

During the twenties and up to about 1928 the coated abrasives industry for the most part used garnet which came from the North Creek mine in the Adirondacks. This supply later gave out and a switch was made to Barton garnet which was mined only a few miles distant from North Creek. It soon became apparent that coated abrasive products made with the Barton garnet did not age well and were susceptible to deterioration while in storage.

It had previously been the practice of the manufacturers of artificial abrasives, i.e. aluminum oxide and silicon carbide, to heat these particular abrasives to a temperature of around 575-650°F. for the purpose of driving off all organic and volatile impurities in order to improve their stability in storage. It had not been found necessary to carry out this heating operation on North Creek garnet or flint. The switch to the Barton garnet necessitated the investigation into the effects of heat treatment. It was soon found that such treatment removed the difficulties previously encountered with Barton garnet abrasives while in storage. Maximum results were obtained by using a temperature of 650°F. Higher temperatures gave no detectable improvement for products in storage.

In the course of carrying out these heat investigations in the Armour and Company Abrasive Research Laboratories, the investigator, Mr. Edwin W. Colt, allowed his imagination to get the best of him

(*Continued on page* 24)

(*Continued from page 23*)
and inadvertently he heated a sample of the garnet crystals to a temperature considerably in excess of 650°F. In fact, the temperature was permitted to soar to 1650°F., unheard of so far as heat treatment of garnet was concerned. The temperature was kept within this range for several hours. After the sample had cooled, it was observed very carefully. There had been a remarkable intensification of the natural red color. Further investigations revealed the change of color was a result of oxidation of the ferrous iron content of the garnet to the ferric form.

It naturally occurred to the experimentor that since a chemical change had obviously taken place, some change in physical properties may also have occurred, for either better or worse.

Since two of the outstanding properties of a good abrasive are hardness and toughness, any effect upon these properties was of primary interest. Since there was no recognized method for testing these properties on fine grits, one had to be devised. The method adopted was one in which the garnet granules were subjected to a standardized grinding operation with a subsequent determination of the reduction in particle size of the sample being ground. It was found that this method could be relied upon to give reproducible results.

As a result of innumerable such tests, it was definitely established that heat treatment of garnet within the range of 750-1650°F., in the presence of air, produces an increase in the hardness and/or toughness of the garnet granules so treated.

It then became necessary to determine what this meant in terms of sanding efficiency. A series of laboratory tests made under standardized conditions of belt speed, pressure, type of wood, etc. proved beyond doubt that heat-treated garnet was superior to untreated garnet in every respect. Typical data are indicated in the following chart. See page 22.

It will be noted from the above chart that under identical conditions heat treated garnet, when made up into abrasive cloth or paper, will cut or abrade 32 ounces of wood in the same period of time that untreated garnet will cut 20 ounces, an efficiency increase of approximately 50%. This is attributable, primarily, to increased hardness imparted to the garnet as a result of heat treatment. This increase in hardness causes the concoidal-fractured edges resulting from chipping of the garnet grains while under work to remain sharper for a longer period of time than do the chipped edges of the untreated, softer grains. It is to be remembered that the cutting efficiency of an abrasive is a function of the permanency of the sharpness of the broken edges of the granules, not the sharpness of their points. It is a common error to consider the latter condition as the basis for good cutting, since the points are not an important factor in this respect. The latter are merely terminations of three or more cutting edges.

Another factor which is commonly overlooked in a good abrasive is the importance of the type of surface of the abrasive granules. Consider how poorly a rusty knife would cut, even though it may have a very keen edge. The frictional effect of abrasive surfaces is similar to that of the blade of a knife. In other words, it is just as important to have the face of a lathe cutting tool highly polished as it is to have the cutting edge of the tool sharp and well-tempered. Garnet surfaces are shiny and glass-like and afford less frictional drag than occurs, say, with aluminum oxide.

Numerous field tests confirmed all of the foregoing laboratory results. As a result, Mr. Colt was granted a U.S. patent (No. 1,836,448, issued 12-15-31), assigned to Armour and Company, protecting this particular discovery. This patent has expired, of course, and now all garnet furnished to the abrasive trade is heat-treated at the Barton mine before distribution.

The foregoing should serve as a very good example of how it is possible for many of us to capitalize upon some of our appearingly wild ideas and convert them into established processes which may serve humanity forever after.

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(*Continued from page 7*)

characteristics of the earth. The next eight dealt with the animal and plant life on the earth, and the last essay described the stars and the planets.

Michigan Gem and Mineral Society was scheduled to visit Woolmith Quarry on July 13. This quarry produces Michigan sulphur and is located about one mile from the village of Scofield. The club states that more and more quarries in Michigan are being closed to the public.

Topeka Gem and Mineral Society will hold their annual show on October 11th and 12th in the Topeka Municipal Auditorium. The show will feature exhibits of gems, mineral, fossils and Indian artifacts. In addition to the exhibits there will be movies and lectures on various geological subjects. There will also be commercial exhibits and dealers. For further information contact J. W. Tyler, 812 Chester, Topeka, Kansas.

Oklahoma Gem and Mineral Society on July 3 heard Haskell Yount tell how to tumble polish baroque stones. Mr. Yount stated that the average rockhound uses too much grit, water, and polishing powder. He recommends that the rocks be immersed in water and then nearly all of the water be poured off before adding either grit or polishing powder. A small amount of Tide may be added to help work up a lather so that the rocks slide smoothly in the tumbler and not bounce about too much. Mr. Yount's tumble-polished gems are noted for their brilliance.

Notice to Advertisers

Our advertisers are respectfully advised that the advertising deadline for the next issue will be OCTOBER 10th for all NEW ADS. Deadline for REPEAT ADS and for NEW PLATES submitted will be OCTOBER 18th.

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***For further details, contact* Bernice Rexin, 3934 North Sherman Blvd., Milwaukee 16, Wisconsin.**

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